Original Article

Performance Assessment of the Acute Physiology and Chronic Health Evaluation IV Scoring System in Outcome of Patients fallowing Acute Poisoning

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Abstract

Background: The present study aims to assess the ability of the acute physiology, chronic health evaluation IV (APACHE IV) scoring system to predict in-hospital mortality of intensive care unit (ICU) patients with acute poisoning.

Materials and Methods: Using data from 622 consecutive ICU admitted poisoned patients, Loghman-e-Hakim Hospital, Tehran, during May 2015-April 2016. Various statistical tools used to assess the correlation, significance, and predictability.

Results: Overall APACHE IV scoring system was statistically significant (P=.001). Death rate prediction, increased from 79.4% to 86.8 % by model, with SMR =0.83%. A meaningful association between APACHE-IV score and the risk of mortality with good discrimination and, calibration (p value of 0.978) was evident.

Conclusion: The present study demonstrates that the APACHE IV system performs acceptably in our patients with acute poisoning and can be utilized as a performance assessment tool in poisoning centers.

Keywords: Acute Drug poisoning, ICU, APACHE IV, Mortality

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Introduction

Poisoning refers to the dose –related adverse effects following exposure to chemicals, drugs, or other xenobiotics. Adverse effects may occur in many forms and ranges from immediate death to subtle changes that is not realized until months or years later[1].

The diagnosis and treatment of poisoning depend upon type and severity of poisoning. Acute poisoning, occurs almost immediately (hours/days) after an exposure. An acute exposure is usually a single dose or a series of doses received within a 24-hour period. Death is a major concern in cases of acute exposures[2]. Acute poisoning needs immediate care and attention. Because the course of acute poisoning is highly depended on the type and dose of drug used and is influenced by an individual's level of tolerance and other factors; its outcome is often unpredictabl, therefore the medical approach to acute poisoning should never confine to the poison and its effects[3]. Consideration must be given to a variety of factors and

key components, which influence the incidence of morbidity/mortality, on time recognition and properly management of critically ill poisoned patients[4].

The factors influencing the course, prognosis and outcome of acutely poisoned patient, depends largely on pattern of pharmaceutical and lethality dose of agents involved; a thorough history and physical examination, sequence, methods, and priorities of management as well as host factors[5]. Mortality risk prediction in patients admitted to intensive care unit (ICU) with acute poisoning has been motivated primarily by a need towards a consistent approach to evaluation and management[6].

The acute physiology and chronic health evaluation IV (APACHE IV), is the most recent and successful version of scoring systems, designed to assess the severity of illness as well as the prognosis (mortality outcome) in critically ill patients in ICU[7]. The objective of this study was to assess the ability of the APACHE IV scoring system to predict mortality in acutely poisoned patients admitted in ICU.

Methods

Study design and data collection: This observational, prospective study was conducted on patients who were admitted to ICU, Loghman-e-Hakim Hospital -Tehran over a period of one year (May 2015-April 2016). The study population consisted of all adult patients admitted with an acute intoxication reason, eligible and fulfilling the inclusion/exclusion criteria for admission to ICU. The extracted data were supporting demographic information (age, gender, place of residence, and main reason of admission) and APACHE IV index applied in the first 24 hours post admission to ICU stay to predict mortality at the end of the acute hospitalization.

The explanatory powers of the APACHE IV model were due to acute physiology parameters, age, chronic health conditions, admission variables, ICU admission diagnosis and mechanical ventilation. Clinical and physiological data on the first day of ICU admission supporting prediction mortality rate were collected from patients' critical care registry data. The results farthest from the baseline (normal) were chosen for the final calculations.

Point scoring of patient's admission information and age: Age> 16 years, length of hospitalized in the ICU<4h (LOS), Readmission, Emergency Surgery.

Point scoring of physiological parameters (APS score) including: Consciousness (eye opening, verbal response, motor response), body temperature, systolic and diastolic blood pressure (B/P), heart rate (HR), respiratory rate (RR), Fio2, arterial PH, Pco2, Po2, serum concentrations of glucose, Na+, creatinine, BUN, urine output (ml/24hrs), albumin, bilirubin, leukocyte (WBC) and hematocrits (HCT) counts. The data for measurements are gathered within the first 24 h of ICU stay.

Point scoring of chronic health condition: Chronic renal failure requiring dialysis therapy (CRF/HD), AIDS, hepatic failure, lymphoma, leukemia/multiple myeloma, metastatic carcinoma, immunosuppression, cirrhosis. If a patient had multiple chronic conditions, the one with the worst score was used[8].

We did not perform mortality predictions for patients younger than 16 years of age; readmitted patients to ICU during the same hospitalization or those transferred from another hospital, and patients died within four hours of admission to ICU .We also excluded post cardio pulmonary resuscitate (CPR) patients. The patients were followed until their outcome on the intensive care unit (death or discharge).

Statistical Analysis: All 622 patients were sequentially evaluated. The baseline characteristics of the patients were expressed as mean±SD or as median with 25th and 75th quartiles as appropriate. Statistical differences between survivors and non-survivors in categorical and continuous variables determined carried out by using chi-square test and Student's t-test. Logistic regression analysis used to determine the variables, which should be included to explain the observed hospital mortality. Pearson's correlation coefficient used to describes both the strength and the direction of the relationship. Area under a receiver operating characteristic (ROC) curve used to test the ability of the model to distinguish patients who die from patients who live (discrimination).

It was classified as excellent to poor according to the Area under the Curve (AUC) values of 0.9 to < 0.6, respectively. Standardized mortality ratio (SMR) with respective 95% confidence intervals (CIs) was

calculated by dividing observed by the predicted ICU mortality rate. A SMR equal to 1.0 indicates that the number of observed mortality equals that of predicted mortality. Statistical analysis was carried out using SPSS version 19.0.In all analysis A significance criterion of P <0.05 was considered statistically significant.

Results

Patient Characteristics: A total of 622 patients met our inclusion criteria., included male , 397(63.8%) ,Female, 225(36.2%)with mean age and standard deviation (Mean ±SD) 35.89±14.9(male 37.38± 15.8,Female 33.2 ± 12.7) were applied to APACHE IV model. Majority (334; 53.7%) of the patients were in age group 20–34 years (male 58.7%, 196; Female 41.3%, 138). The total number of survivors and non-survivors were 474 (76.2%) and 148 (23.8%) respectively .61.3 % of patient ventilated during first 24 hours (Table 1).

Poisoning Profile: The primary clinical diagnosis made on ED based on exposure history and focused on patient's signs and symptoms. Patients hospitalized with a history of known drugs or toxic chemicals in 91.5% (n=569) and with uncertain or unreliable history in 8.5% (n=53) which kept under close observe and waited for lab results. The most common cause of acute poisoning was drugs 41.3% (multiple drug toxicity (MD) 19.9%, tricyclic anti-depressant (TCA) 9.0%, anticonvulsant 5.3%, benzodiazepines 4.8%). Illegal drug and substance overdose 26.4% (opium 9.2%, methadone 8.8%, shisha 3.7% and tramadol 4.7%), chemical 23.8% (alminum phosphid 13.3%, organophosphorus compounds 6.8%, methanol 2.9% and carbon dioxide (CO2) 0.8%) and unknown drugs 8.5%. Aluminum phosphide toxicity 96.4% (n=80) was the most frequent cause of death (Table 1).

APACHE IV Scores: The results from applying the APACHE IV model for ICU admitted acutely poisoned patients to the validation data set are given in Table 2. Majority of patients (75.9%, no=472) had APACHE IV score <30, out of those, 87.4% survived and 31.3% died whereas 24.1 %(no=150) patients had APACHE IV score >30, out of those 12.6% discharged and 68.8% did not (p<0.001). The mean and standard deviation (Mean ± SD) APACHE IV score of over all patients was 25.57±2.18 (Median=17.0), 95% CI= ±0.17 (25.4–25.7), survivors' 15.14±.6.8 (Median=13), 95% CI= ±0.6 (14.54–15.74); non- survivors' 65.85 (±9.4) (Median=65), 95% CI=±1.63 (64.22–67.48).

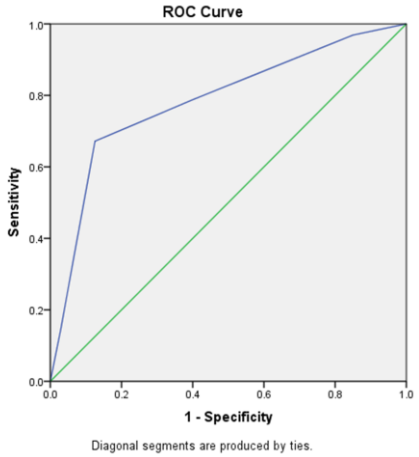

Figure 1. APACHE IV model discrimination and accuracy for sample study.

APACHE IV predicted mortality rate: Based on Logistic regression analysis, overall the model was statistically significant (chi-square=9.172.df=8, P=.001). The death rate, predicted significantly by APACHE IV scoring system (increased from 79.4% to 85.2 %for the null model), with sensitivity=89.31%, 95% CI: 89.35% to 91.83 percentage; specify=73.47%, 95%CI: 63.59% to 81.88%.; diagnostic value =84.24%, 95% CI: 81.14% to 87.02 %; and SMR =0.83%, 95%CI: 0.8717% to 1.233%.

Performance of APACHE IV model on prediction of hospital mortality: The performance assessment of the APACHE IV model showed in Table 3 and Figure 1. It shows, original APACHE IV model had a fair discrimination and accuracy (AUC=0.78, p value=0.01, 95% CI =0.73 % to 0.83), and good calibration (chi-square=5.079, df=8, p value=0.749) for our sample study. The Wald criterion demonstrated that sex (p=0.03) and poisoning strength of a chemical (p = .009), made significant contributions to prediction.

Table 1: Study characteristics and Poisoning Profileof patients in survivor and non-survivor groups.

Variable	**Outcome**			
	Survival (494, 79.4%)		**Non-survival (128, 20.6%)**	
	Number of cases (%)	**Mean±SD**	**Number of cases (%)**	**Mean±SD**
Sex				
Male	397(63.8%)			
Female	225(36.25)			
Age (year)		36.11±15.34		35.04± 13.11
< 20	32 (6.5%)		2 (1.6%)	
20-34	260(52.6%)		74(57.8%)	
35-49	101(20.4%)		35(27.3%)	
50-65	73(14.8%)		13(10.2%)	
> 65	28(5.7%)		4(3.1%)	
Toxic Substance	494(79.4%)		128(20.6%)	
Drugs(41.3%,257)	225(45.5%)		32(25.0%)	
Illegal sub.(26.4%,164)	155(31.4%)		9(7.0%)	
Chemicals(23.8%,148)	64(13.0%)		84(65.6%)	
Unknown (8.5%,53)	50(10.1%)		3(2.3%)	

Table 2: APACHE-IV score and patient's outcome (n=622).

APACHE IV score	**Survival Patients discharged**			**Non-Suvival**		
	Number of patients	**Mean±SD**	**CI**	**Number of patients**	**Mean±SD**	**CI**
0-10	149(24.0%)	15.14±6.8	± 0.6(14.54–15.74	3(0.5%)	65.85±9.4	±1.63 (64.22–67.48
11-20	210(33.8%)			17(2.7%)		
21-30	39(6.3%)			0(0.0%)		
31-40	36(5.8%)			0(0.0%)		
41-50	0(0.0%)			50(8.0%)		
51-60	32(5.1%)			26(4.2%)		
61-70	22(3.5%)			18(2.9%)		
>70	6(1.0%)			14(2.3%)		
Total	494(79.4%)			128(20.6%)		

Discussion

Acute poisoning by drugs and chemicals is usually a critical, short-lived event, which necessitates immediate care. A major problem of studies on prognosis of acute poisoning arises from the type and dose of toxic agents and is influenced by an individual's level of tolerance and other factors. Since the substance involved may be one of controlled substances, prescription medicines, over-the-counter (OTC) medicines, or even complex mixtures such as traditional remedies, Clinical assessment of severity of poisoning is essential component of patient's care[9].

Although accurate history and appropriate physical examination are helpful tools for decision making in

Table 3: APACHE IV predicted mortality rate.

Situation		ROC Curve					Diagnostic Value (95% CI)	SMR (95% CI)
		Predict Apache IV			AUC	(95% CI)		
		Alive	Expired	Total	0.785	0.736–0.833	88% (81.14 - 857.02 %)	1.45 (1.21-1.72)
Observed	Alive	468	26	494	94.7%			
	Expired	66	62	128	48.4%			
Overall Percentage		534	88	622	85.2%			

Sensitivity =62/88=70.4%; Specificity = 468/534=87.6%; Diagnostic Value =(62+468)/622=88%; SMR=128/88=1.45

acutely poisoned patient, a number of approaches based on scoring systems to predict ICU mortality rate, have been developed over the past decades. Acute physiological and chronic health examination scoring system (APACHE IV) was used with well performance in predicting the mortality and outcome in critically ill patients[10].

In our prospective observational study, 622 patients intentionally exposed to variety of drugs or chemicals, treated in ICU. Among a variety of Factors that independently predict a worse outcome in patients with acute poisoning; sex, type of substance involved and higher values in scoring systems were the most significant ($p<0.05$). Univariate analysis for outcome among the enrolled patients in our sample showed that, Drug poisoning deaths was higher among men (63.8%) in age group 20-34 (53.7%), accordance with findings of other studies[11, 12].

The drugs and chemicals used for self-harm depend upon their availability upon some national and local practices. In this study multiple drug toxicity (MD) was the most common reason of transforming intoxicated patients to ICU and Aluminum phosphide toxicity 96.4% (n=80), was the most frequent cause of death Alminume phosphid poisoning had the highest mortality rate (96.4%). Aluminum phosphide is classified as immediately dangerous to life by Centers for disease control and prevention (CDC)[13], widely used in north India and other parts of southeast asia as a common agent for suicide[14,15].

In Iran, suicidal intent by Aluminum phosphide is increasing day by day with high mortality rate[16]. In using APACHE IV Prediction model for patients with acute drug poisoning in this study, our results demonstrate that median APACHE IV scores for survivals was 13 (interquartile range: 10-19) and for non-survival was 65 (interquartile range: 60-72.5). The score of predicting model was significantly higher in survivors than in non-survivors, observed by other studies[17,18].

Based on univrient statistics, a significant associated ($P<0.05$) was observed between sex, type of substance involved, early need of mechanical ventilation, underlying health problem, blood pressure, arterial blood gas (ABG), blood glucose and mortality risk. APACHE IV scores was significantly different between survivors and non- survivors groups ($P=0.001$). All scores were significantly higher in non-survivors. It was also observed that the likelihood of mortality increased as the score increased as other studies[19]. APACHE IV model for ICU poisoning prediction mortality model had showed excellent calibration (Lemeshow – Hosmer goodness of fit test, p value = 0, 977) and discrimination (sensitivity (70.4%), Specifity (87.6%), area under the curves, AU-ROC=0.88) Similar to other studies[20,21].

Conclusion

The main conclusions from the study show, a meaningful association between APACHE-IV score and the risk of mortality, which is comparable with

other studies[22]. Prognosis of poisoning is difficult to estimate accurately due to unreliable clinical history, multiple/unknown ingestions. The APACHE IV scoring system, predicted the death close to the actual mortality with good calibration (the ability of a model to match predicted and observer death across the entire spread of the data) and discrimination i.e. ability to distinguish survivors and non-survivors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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